

The Power Source of Mathematics Teachers' Teaching Reflection

Cunrong Wang*, Miaomiao Yang, Guangming Zheng

Division of Mathematics and Artificial Intelligence, Qilu University of Technology (Shandong Academy of Sciences), Jinan, 250353, China

**Corresponding author: 1191984686@qq.com*

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Abstract: No matter traditional education or wisdom education, rationality and validity of teaching practice are eternal demands. The rationality and effectiveness of teaching practice are realized in teachers' continuous reflection. Although the social constraint of education determines that teachers' reflection needs various external reinforcement and external support. However, this paper mainly studies the four factors that push mathematics teachers to reflect on teaching, which are educational theory learning, teaching self-evaluation, "problem solving" in mathematics, dialogue and communication among teaching subjects.

1. Introduction

No matter traditional education or wisdom education, the rationality and validity of teaching practice are eternal demands. The rationality and validity of teaching practice are realized in teachers' continuous reflection, because only by teachers' continuous reflection, can they continuously discover and successfully solve the problems in teaching practice. As the German philosopher Gadamer said, the object of reflection always gives new answers to those who ask it and raises new questions to those who answer its questions [1]. Therefore, it is particularly important to study the problems related to teachers' reflection. This paper mainly studies the promoting effect of teachers' learning of educational theory, teaching self-evaluation, dialogue and communication among teaching subjects, as well as "problem solving" in mathematics on teachers' educational reflection.

2. The Power Source of Mathematics Teachers' Educational Reflection

Teachers' learning of educational theory, teaching self-evaluation, dialogue and communication among teaching subjects as well as "problem solving" in mathematics are the source of motivation for mathematics teachers to conduct teaching reflection.

2.1 Teaching Reflection Is Guided by Learning Educational Theories

For some teachers, teaching becomes copying others and then repeating their own activities. These teachers are unable to identify teaching problems, let alone solve them, because they have neither the consciousness nor the ability to reflect. What can help teachers enhance the reflective consciousness, improve the reflective ability? Educational theory study is one of the effective ways to enhance teachers' reflective consciousness and ability. Theories enable us to view familiar things from a variety of perspectives and think about familiar things from a variety of dimensions. Theory can clarify the general factors in practice, thus theory helps us to identify our own practice [2]. Educational theory can help teachers to catch problems in the teaching phenomenon of the moment and find problems where there seem to be no problems.

Teachers' reflection can be divided into intuitive reflection and rational reflection according to the depth of thinking. Intuitive reflection means that teachers can judge whether a certain teaching behavior is appropriate and correct only by intuition or common sense, without more in-depth thinking. For example, whether the teachers' speaking speed is appropriate or whether the blackboard writing is organized can be judged by the teachers' intuitive reflection. Rational reflection means that it is difficult to determine the rationality of some teaching behaviors, so teachers need to analyze and research based on certain educational theories [3]. In other words, teachers' rational reflection is the theoretical reflection on teaching practice and the reflection that needs the guidance of educational theory.

For example, whether it is traditional teaching or hybrid teaching, some teachers are filling the students with knowledge and hardly hear the students' voices. In the teaching combined with practice, the evaluation subject is the teacher on the merits of students' problem-solving methods and the rights and wrongs of problem-solving process, and there is no feedback from students. Behaviorism teaching view and constructivism learning view can help these teachers examine, reflect and revise their own teaching behavior. Only in this way can they fully realize the main role of students in teaching, fully mobilize students' learning initiative and enthusiasm, and improve the effectiveness of teaching.

Only by studying the problems reflected in the teaching practice to the theoretical level can we find an effective way to solve the problems. Only by explaining and constructing our teaching experience from the theoretical level can we realize the theoretical improvement of teaching practice. Educational theory can not only help teachers find teaching problems, analyze teaching problems and solve teaching problems, but also keep teachers thinking and updating. Therefore, continuous learning of educational theory is an inexhaustible motivation for teachers to reflect.

2.2 Teaching Reflection Is Led by Teaching Self-evaluation

Self-evaluation is the subject's evaluation of himself. Carrying out teacher self-evaluation can promote teachers to carefully study and understand the educational objectives, tasks and requirements, so as to reflect on their own teaching philosophy and teaching behavior. Teachers use the results of self-evaluation to improve their teaching ideas, regulate and perfect their teaching behavior, and improve the rationality of teaching practice. In this sense, self-evaluation is the internal motivation of teachers' teaching self-reflection. Modern psychological research shows that internal motivation has a longer lasting effect than external stimulus.

Humanistic psychology proposes that the emergence and development of self-knowledge is also subject to others, especially in the initial stage. In the process of self-evaluation, teachers tend to be influenced by external factors, especially external evaluation, and overestimate or underestimate themselves. However, overestimated or underestimated teaching self-evaluation can interfere with or even hinder teachers' teaching reflection. Overestimated high teaching self-evaluation tends to

make teachers ignore the problems existing in teaching practice, while underestimated teaching self-evaluation tends to make teachers deal with the problems in teaching passively. Therefore, only continuous and accurate self-evaluation of teachers' teaching can really promote teaching reflection.

Charlotte Danielson believes that teacher evaluation is based on meeting the basic requirements of society and school for teachers' work (external value scale). After reflection, teachers establish development goals based on their own characteristics and self-orientation (internal value scale). That is to say, self-evaluation is not an "exclusive" or "closed" evaluation. Teachers should evaluate themselves according to the standard of external value scale and maximize the integration of external value scale and internal value scale.

However, external evaluation of teachers is sometimes inappropriate. For example, school supervisors consider classroom teaching without student discussion or classroom teaching without the use of modern educational technology as substandard teaching. Such a standard of evaluation is too rigid. Teachers have the right to independently decide the teaching methods according to the teaching content, students' knowledge level and teachers' teaching style.

In order to ensure the objectivity, accuracy and effectiveness of self-evaluation, teachers should correctly treat the evaluation of school supervisors, education and teaching experts, students and colleagues, absorb the reasonable elements of their evaluation factually and critically, fully understand their own advantages, and frankly face their weaknesses. Only such self-evaluation can really lead teachers to reflect on teaching.

2.3 Teaching Reflection Is Facilitated by "Problem Solving"

Since National Council of Teachers of Mathematics (NCTM) launched the reform movement of mathematics education with the banner of "problem solving" in the 1980s, the mathematics education with the core of "problem solving" has become the focus of research. What is the goal of mathematics education with "problem solving" as the core? "What I hope is not just to teach my students to solve problems -- especially problems posed by others -- but to help them to think mathematically. Thinking mathematically means seeing the world through the eyes of a mathematician and having the ability to successfully mathematize it." said Professor A. Schoenfeld, one of the leading figures in modern research on problem solving [4]. That is to say, we cannot take problem solving as the ultimate goal of teaching. The ultimate goal of teaching should be to help students learn to think mathematically.

In order to help students learn to "think mathematically", teachers should play the role of organizers and guides. Teachers should urge students to "clarify the problem" and observe their problem-solving behavior. If a student is in trouble, the teacher should give the student some inspiration on how to choose and implement problem-solving strategies. If a student gets a solution, the teacher should ask the student to test it and generalize about the problem or ask the student to explore a better solution. After the students' problem-solving activities, the teacher should organize the whole class to compare different problem-solving methods and distinguish wrong solutions. From this process we can see the important role of reflection in "problem solving". As F. Sherver pointed out, no model of problem solving can be complete without fully reflecting the role of reflective and conceptual systems [5]. In fact, teachers are guiding students to reflect on the following questions. What do we know about the problem? What is the unknown condition? Is the strategy of reflection correct when thinking is blocked? Should we continue this strategy or change it? When you get a solution, reflect on whether the solution is correct? Is there a better solution? Can you generalize and extend the problem? Among the various solutions, what is unique about each method? What is wrong with some of the wrong solutions? Why did this error occur? How should errors be corrected? In this process of pursuing the best thinking and seeking the best

solution, students' mathematical thinking ability produces novelty and originality, and students' reflective ability is well cultivated and developed.

A series of problems in the process of "problem solving" can reflect the problems existing in teachers' teaching. For example, students have unclear concepts, cannot transfer the knowledge they have learned flexibly, have a misunderstanding of the theorems they have learned, and have no real understanding of some mathematical thoughts and methods. Teaching and solving doubts are the pursuit of any responsible teacher. Teachers should reflect on what kind of teaching content and teaching methods to solve students' doubts. At the same time, teachers should reflect on their professional knowledge, reflect on their teaching skills, reflect on their teaching ability, and reflect on their teaching concepts. Through reflection, teachers can constantly update their teaching concepts, improve their teaching behaviors, and enhance their teaching level. At the same time, teachers can form their own independent thinking and creative opinions on teaching phenomena, teaching problems and teaching theories, which will ultimately improve the rationality of teaching practice and enhance their reflective ability. That is to say, in the "problem solving" of mathematics, students' respective thoughts, correct or wrong solutions and confused knowledge are the objects of reflection of teachers. Teachers can improve their teaching reflection ability through reflection - problem solving - reflection.

2.4 Teaching Reflection Is Expanded by Dialogue and Communication

The complexity of teaching system is determined by the diversity of educational objects, the openness of teaching content, the selectivity of teaching methods and the variability of teaching environment. The abstractness of mathematical objects, the exploratory nature of mathematical activities, the rigor of mathematical reasoning and the formality of mathematical language determine the reflective nature of mathematical learning. That is to say, in the process of mathematical learning, students cannot grasp the connotation and essence of mathematical knowledge (concepts, theorems, thinking methods, etc.) all at once. Students need to think in learning and learn from thinking.

First, the dialogue and communication between teachers and students can expand the content of teachers' teaching reflection. In the complex teaching system and students' reflective learning, teachers can only tell students what they want to know (a certain concept, theorem or method of thinking, etc.) and give students what they need (guidance and help, etc.) by making timely and accurate diagnosis of students' learning situation. Dialogue and communication (between teachers and teachers, between teachers and students, between students and students, etc.) are the main ways for teachers to make timely and accurate diagnosis, as well as the main ways to expand reflection and promote reflection. Dialogue and communication between teachers and students are the main way for teachers to make timely and accurate diagnosis, as well as the main way to expand reflection and promote reflection.

Second, dialogue and communication between teachers provide emotional support for teaching reflection. Teaching reflection is the process of finding and solving teaching problems. Some teachers will feel frustrated and helpless when they find that they are not able to solve some teaching problems. Of course, school leaders can help and support teachers, but dialogue and communication between teachers can save teachers from negative situations.

As each teacher has different life experience, growth experience, teaching style and professional expertise, he/she can have different levels, aspects and perspectives on the same teaching problem. Through dialogue and communication, teachers share their views and information, they are able to identify new problems and come up with new and better problem-solving strategies to make teaching practices more reasonable. Through dialogue and communication, teachers can learn from

others and thus enhance self-efficacy [6]. A. Bandura defines self-efficacy as the belief in the ability to organize and execute behavioral processes required to produce certain results [7]. Teachers' self-efficacy means that teachers believe they have the ability to find and solve problems in teaching practice successfully. Teachers' self-efficacy means that teachers believe they have the ability to find and solve problems in teaching practice successfully. Teachers' self-efficacy means that teachers believe they have the ability to find and solve problems in teaching practice successfully. Even if some teaching problems have not been solved, teachers with strong sense of self-efficacy can find out the reasons from all aspects, not just due to their poor ability and shallow knowledge. In this sense, teachers' self-efficacy is a positive emotional factor to maintain and promote reflection. Therefore, dialogue and communication among teachers can provide a positive emotional support for teaching reflection by enhancing teachers' sense of self-efficacy.

3. Conclusions

This paper mainly studies the four factors that push mathematics teachers to reflect on teaching, which are educational theory learning, teaching self-evaluation, "problem solving" in mathematics, dialogue and communication among teaching subjects.

However, this paper is only a brick to attract jade. There are still many problems about teaching reflection that need further investigation and research. For example, what are the specific methods of teaching reflection? How to apply these methods to teaching reflection? How to conduct empirical Research on Teaching Reflection?

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References

- [1] Hans-George Gadamer. Translated by Handing Hong. (2004) *Truth and Method: Fundamental Features of Philosophical Hermeneutics*. Shanghai: Shanghai Translation Press, 56.
- [2] Stephen D. Brookfield. Translated by Wei Zhong. (2002) *Critical Reflective Teacher ABC*. Beijing: China Light Industry Press, 45.
- [3] Hongbo Lv. (2006) *The Teacher's Method of Reflection*. Beijing: Education Science Press, 40.
- [4] Yuxin Zheng. (1998) *Philosophy of Mathematics Education*. Shanghai: Shanghai Education Press, 455.
- [5] Yuxin Zheng and Guancheng Liang. (1998) *Cognitive Science Constructivism and Mathematics Education*. Shanghai: Shanghai Education Press, 51.
- [6] Karen F. Rooney, and Robert B. Kottkamp. Translated by Zheng Dandan. (2007) *Reflective Practice of Educators: Promoting Student Learning through Professional Development*. Beijing: China Light Industry Press, 208.
- [7] Pi Liansheng. (1999) *Educational Psychology*. Shanghai: Shanghai Translation Press, 56.